# Emerging Technologies in Buildings: A Look at the Future

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# Emerging Technologies in Buildings: A Look at the Future

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Scott Hackel, Slipstream

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# Trends in building energy

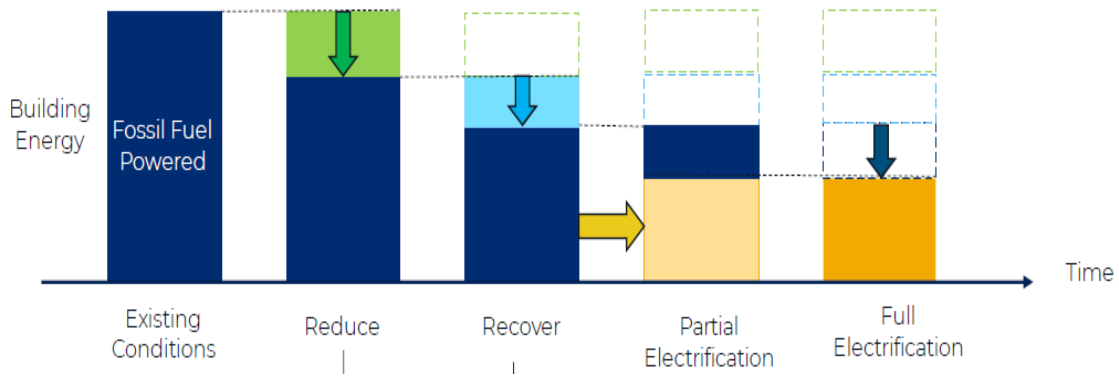
# AI impacts are arriving.

- Data center loads, yes…

  but also…
- AI in buildings
- AI for workforce
- AI for …

# Carbon goals still here.

- Corporate and municipal
- Requires planning:

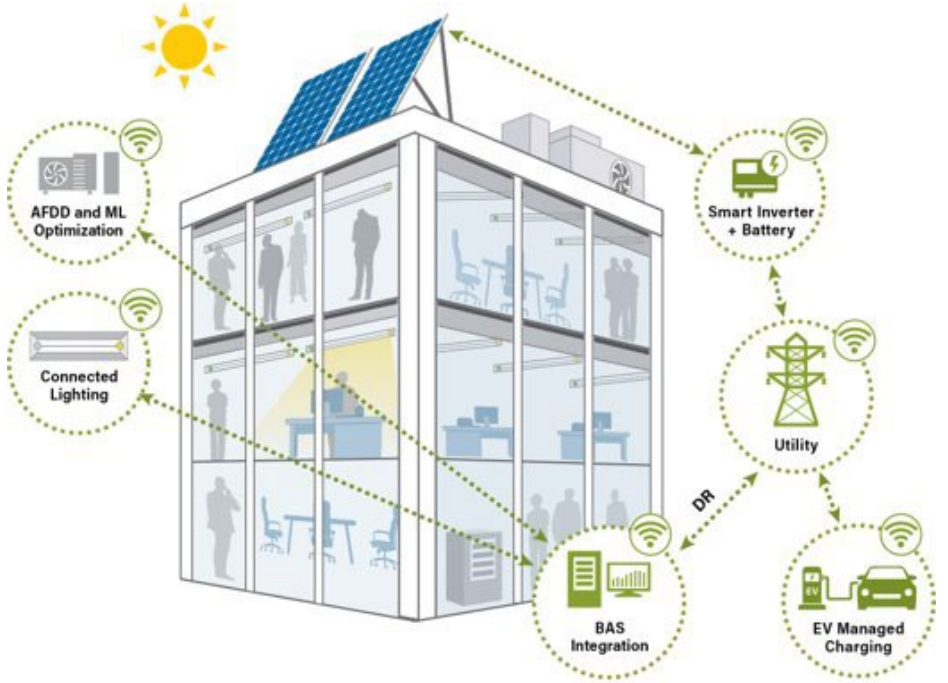


# Transportation is a building load.

- Fleet
- Public
- Multifamily

# The grid is constrained – there's value in that.

- Shaping for flexibility
- Shedding for resilience
- Storage for both



**2-3 million** – number of clean energy jobs to be added in the United States by 2030

**+8–19%** – wage increase for those shifting to the industry

Source: Forbes, Clean Energy Jobs Are Booming, Making Up For Rising Fossil Fuel Unemployment

# Dual Fuel Heat Pump RTUs and Integrated ERVs

Next Gen
Rooftop Units

# Dual Fuel (Hybrid) Heat Pump RTUs

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## Dual fuel heat pump RTU operating in heat pump mode (furnace is off)

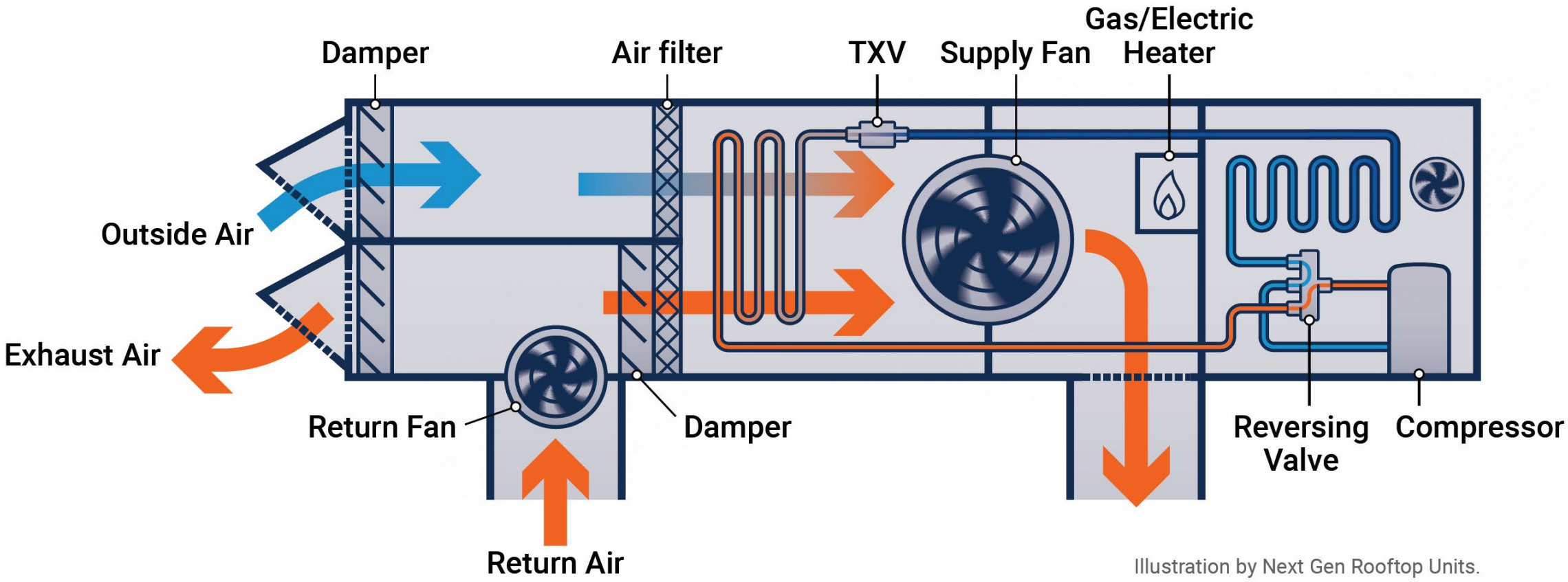


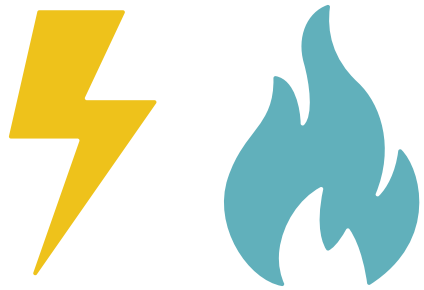

Illustration by Next Gen Rooftop Units.

# Heat pumps regularly see efficiency of 250% or greater

- Same footprint
- Same box
- Similar weight
- Similar electrical load

# Dual fuel (hybrid) heat pump RTUs best of both worlds

- Can run heat pump and burner simultaneously **or** switch over at temp
- Reduce gas use and site carbon emissions
- Utilize gas on our coldest days or when electricity is too expensive.



***Boost your business***

Clients who are already interested in energy savings or electrification are a great audience for dual fuel heat pump RTUs

# Case Study: Room and Board - Golden Valley, MN

**Building Type:** Split office/warehouse, single story

**Reduction in Gas use:** No gas consumed

**Local Utility:** Xcel Energy (electric)
CenterPoint Energy (gas)


- Like for like replacement exchanging standard RTU for all electric heat pump RTU
- Furniture retailer looking to reduce energy consumption to meet their commitment to sustainability
- Chose all electric despite cold temperatures
  - Value reduced carbon over bill savings
  - Heating interior space, no exterior walls
- Next Gen RTU Initiative demonstration project:
  - Analyzed energy performance and efficiency
  - Evaluated various control strategies
- Integrated with other sustainability measures including ERVs and solar panels

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# Case Study: Children's Dental, Minneapolis MN

**Building Type:** Single-story medical office building

**Reduction in Gas use:** Gas heat accounted for 65% of heating season

**Local Utility:** Xcel Energy (electric) CenterPoint Energy (gas)

- Like for like replacement exchanging standard RTU for all electric heat pump RTU
- Dentist office looking to reduce energy consumption
- Dual fuel heat pump RTU
  - No upgrade to building infrastructure
  - No change to energy bills
- Next Gen RTU Initiative demonstration project:
  - Analyzed energy performance and efficiency
  - Evaluated various control strategies
- Integrated with other sustainability measures including solar panels

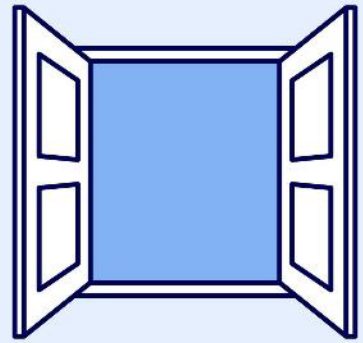
Next Gen Rooftop Units

# Integrated Energy Recovery Ventilators

Next Gen
Rooftop Units

# The problem with standard RTUs? Wasted Energy- Winter

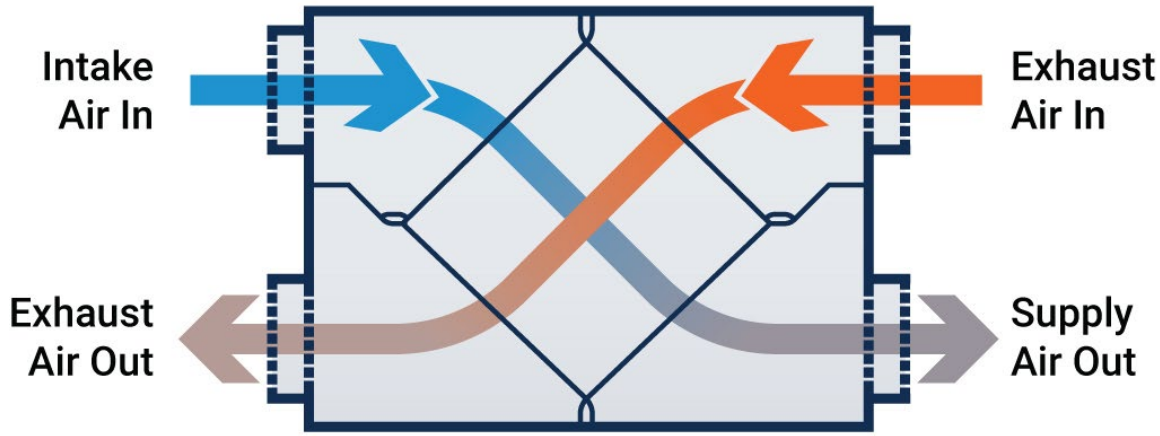
- In the winter, energy is spent to heat the cold outdoor air
- *Warm* air is then released with *exhaust* air, losing the energy spent to heat it
- "Cold blow" as equipment heats up



Next Gen Rooftop Units

# A solution? ERVs Energy Recovery Ventilators

- Reduces energy waste from RTU exhaust ventilation
- 30%-90% reduction in ventilation energy use
- Balances humidity and increases comfort




Winter Operation of ERV

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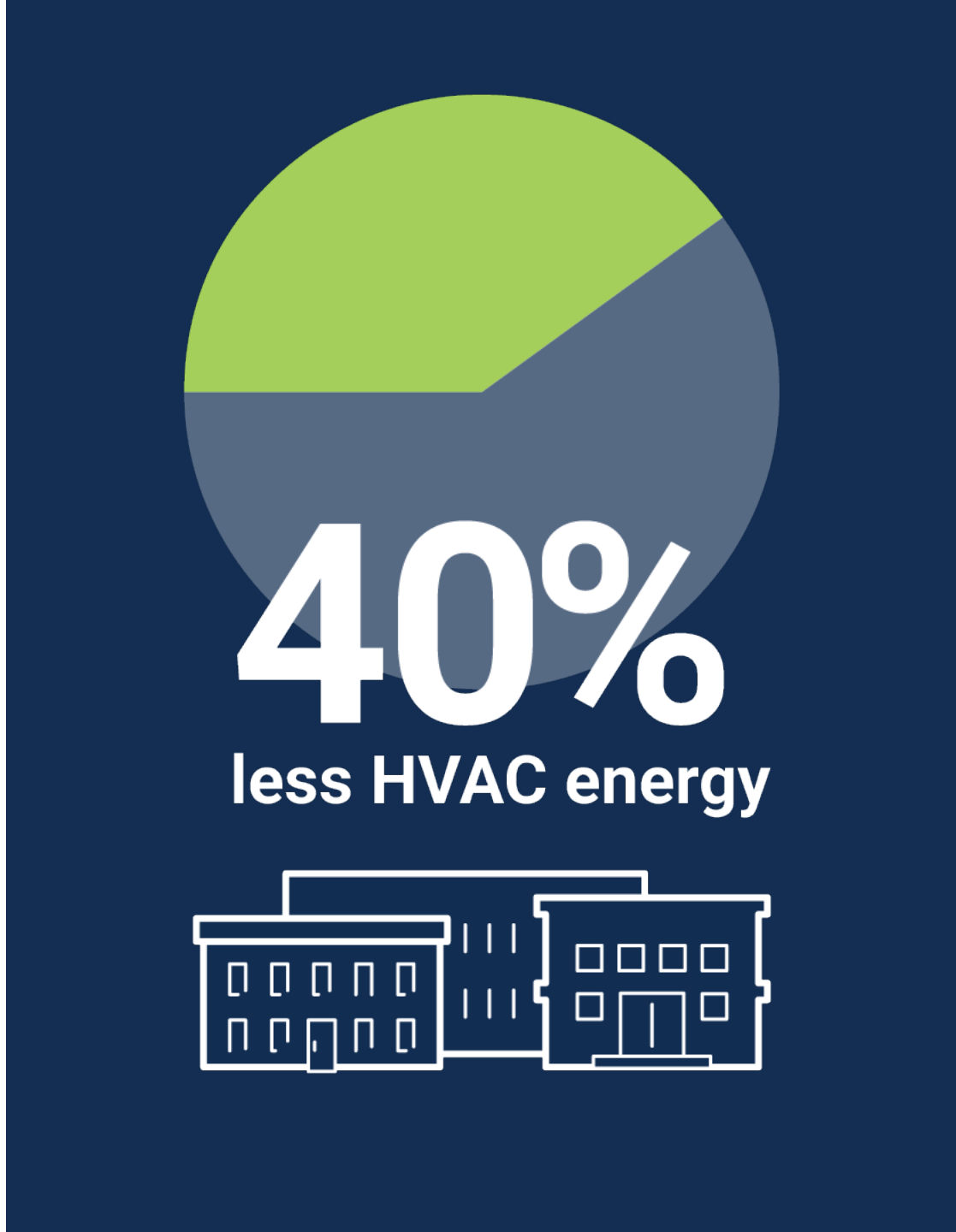
# Integrated ERVs

- Wheel or Membrane
- 60% effectiveness or higher
- No need to integrate controls
- No curb adjustment

Next Gen Rooftop Units

# Dual Fuel Heat Pumps RTUs and ERVs can reduce HVAC energy use by 40%



# Startup and Controls

- Startup is the MOST important day in the life of the unit
- Mistakes made at startup may continue for months or years
- Startup and controls have small but important changes when adding a heat pump or ERV

# Emerging building control tech

# ASHRAE Guideline 36

Uniform, **best-in-class sequence of operations** for HVAC systems to maximize efficiency, performance, and control

- General logic: PID loops, point override, VFD minimums, trim & respond, equipment staging, alarms
- VAV terminal dual-maximum logic
- Demand- based temperature & pressure reset
- Demand-controlled & occupied-standby ventilation (T24 & ASHRAE 62.1)
- Logic for any plant configuration
- Real-time fault detection & diagnostics
- Demand response
- Hierarchical alarm suppression
- Economizer: sequencing, high limit lockout, building pressure control
- Equipment staging controls
- Reset request logic

# California Field Demonstration Results

| | HVAC Savings | Whole Building Savings | Estimated First Costs* | Simple Payback | Project Scope |
|---|---|---|---|---|---|
| KP Vallejo Medical Office Building | 78% electricity<br>40% CHW<br>61% HW | 45% | $1.7M<br>($8.50/sqft) | 8 yrs | Complete hardware retrofit to replace existing pneumatic controllers |
| KP Whittier Medical Office Building | 81% Fan & Cool<br>35% HW | 35% | $323k *<br>($9.51/sqft) | 6 yrs | |
| KP Pleasanton Data Center Offices | 65% Fan<br>27% CHW<br>15% gas | 16% | $27k **<br>($1.14/sqft) | 2 yrs | Re-programming only using exiting BAS hardware |
| Contra Costa College Admin Building | 38% Fan<br>35% CHW<br>4% HW | 8% | $41k<br>($1.00/sqft) | 7 yrs | |

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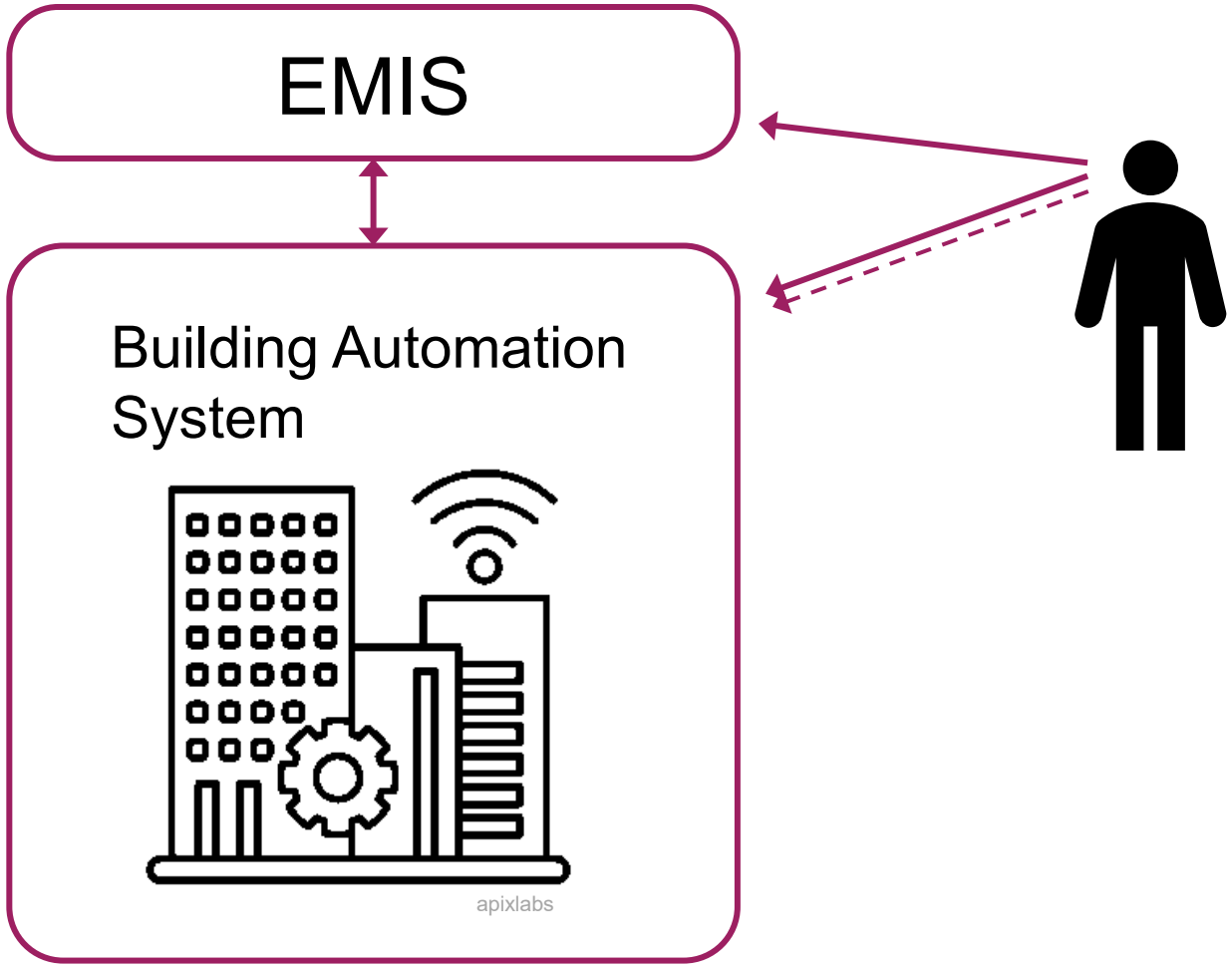
# ASHRAE Guideline 36 Benefits

| | FACILITIES MANAGEMENT | OWNER/ CUSTOMER | DESIGN ENGINEER | CONTROLS CONTRACTOR | CONTROLS MANUFACTURER | COMMISSIONING AGENT |
|---|---|---|---|---|---|---|
| Energy | | Reduced energy use & costs | | | | |
| Implementation Effort | Reduced staff training & maintenance cost | Lower design & construction costs | Less effort to design | Less effort to implement | | Less effort to test |
| Occupant | Fewer occupant complaints | Improved thermal comfort | | | | |
| Building operations | Improved operations | Higher quality | | | | |
| Market share | | | | Increased market demand | | |
| Customer satisfaction | | | Increased customer satisfaction | | | |

**Challenges do remain in realizing these benefits.**

# Energy Management Information Systems (EMIS)



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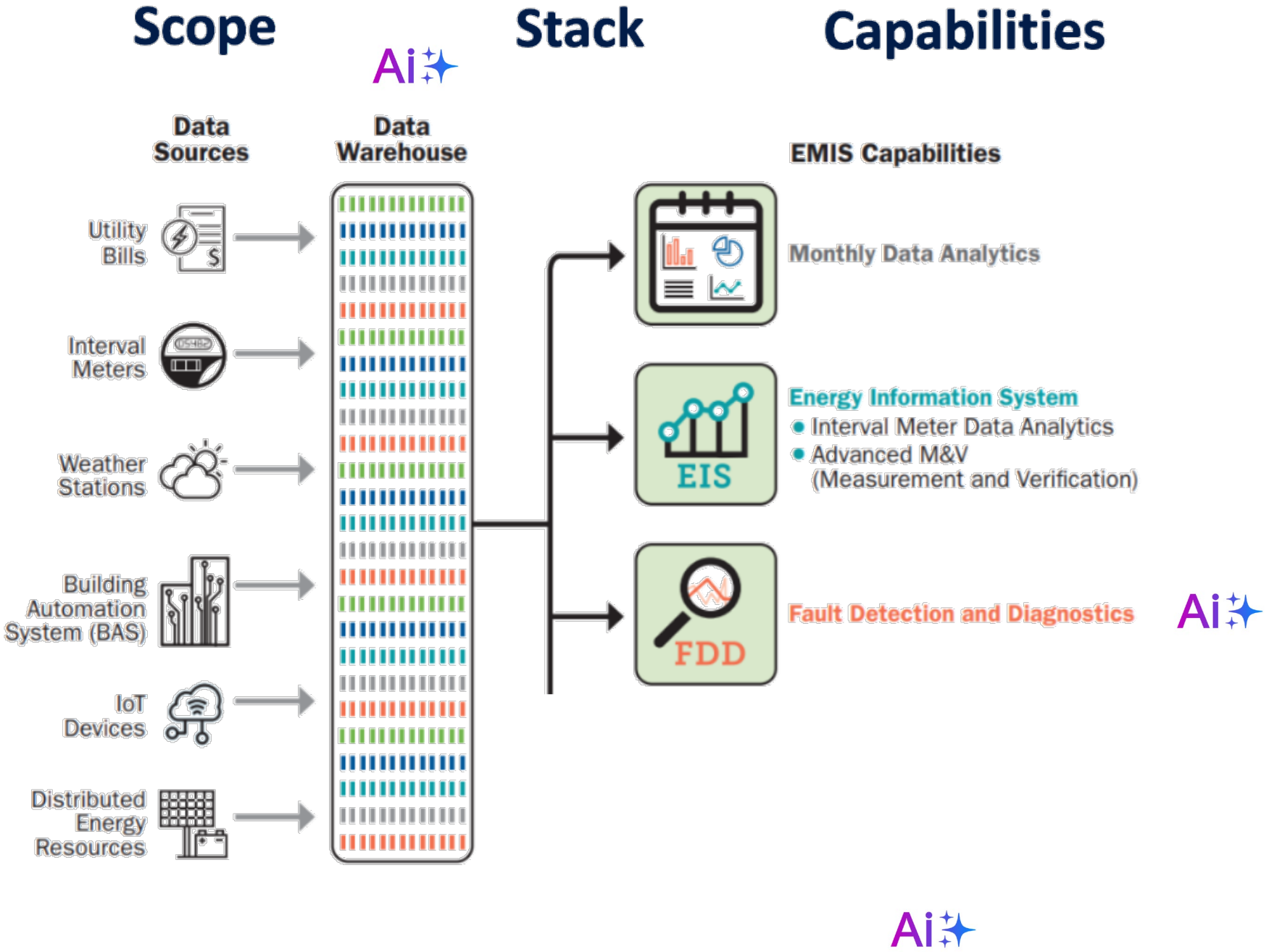


# Automated Supervisory Optimization

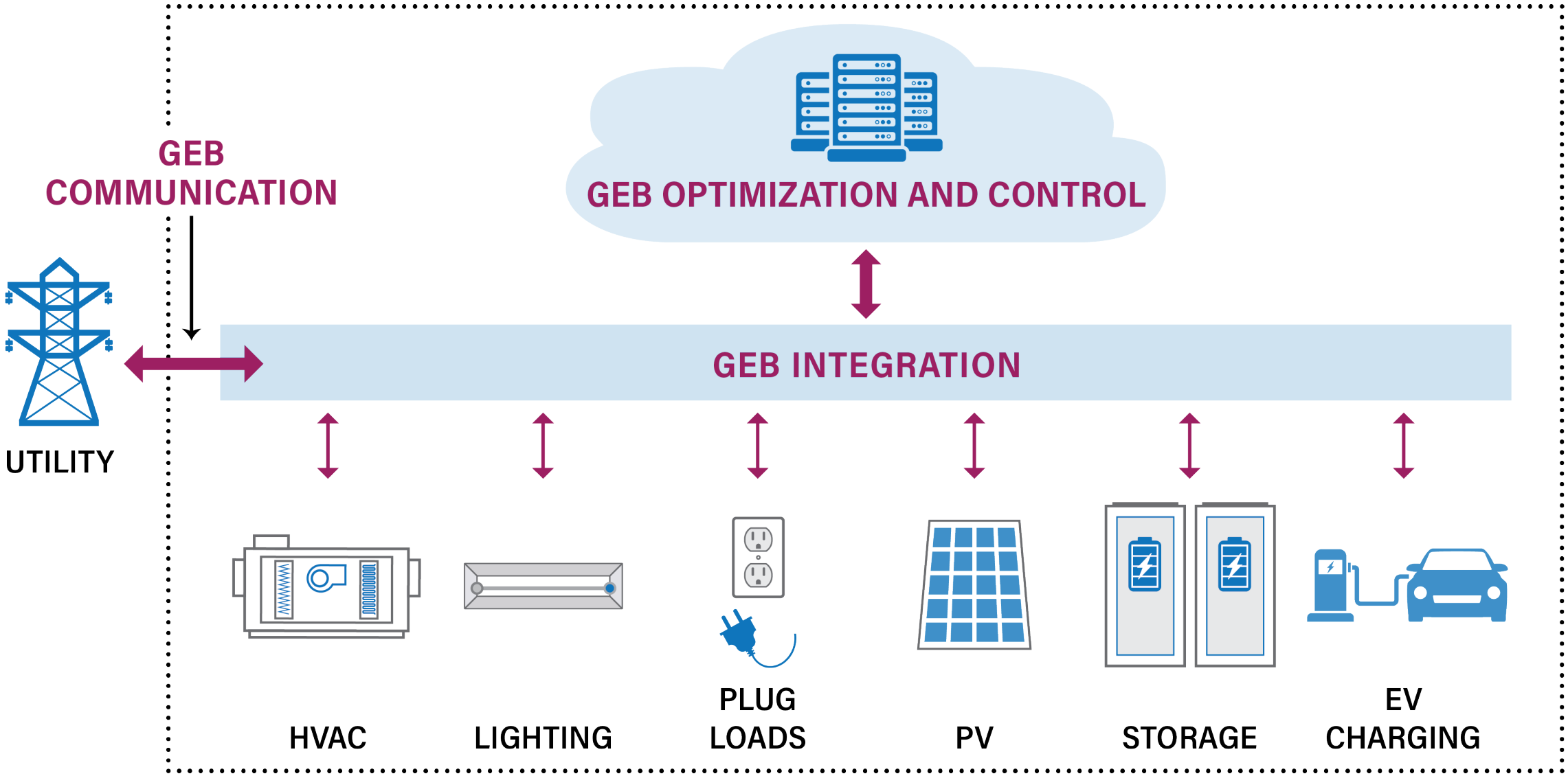
## What is ASO?

- Software that continuously analyzes and modifies BAS control settings to **optimize HVAC system energy usage** while maintaining occupant comfort

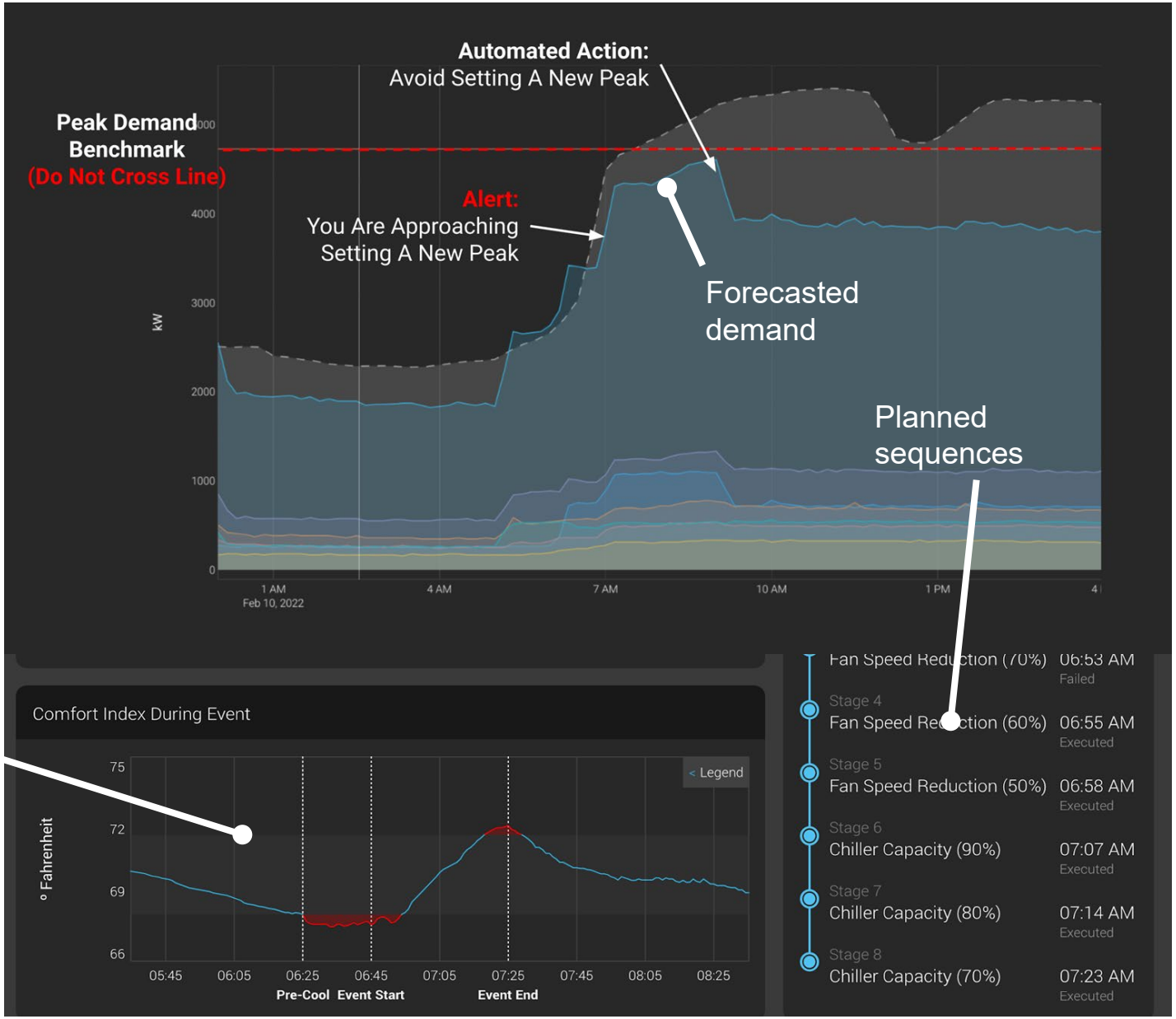
## Why ASO?

- Prevent HVAC system performance degrading over time:
  - Operator turnover, cold calls, system adjustments, etc.
- Easy implementation of Guideline 36
- Enable building-level optimization and coordination
- Maximize objectives: energy savings, cost savings, carbon emissions, grid services
- **Enable potential for further AI benefits**

# Grid-interactive, Efficient Building (GEB) Control



# GEB enabled by EMIS




Forecasted comfort

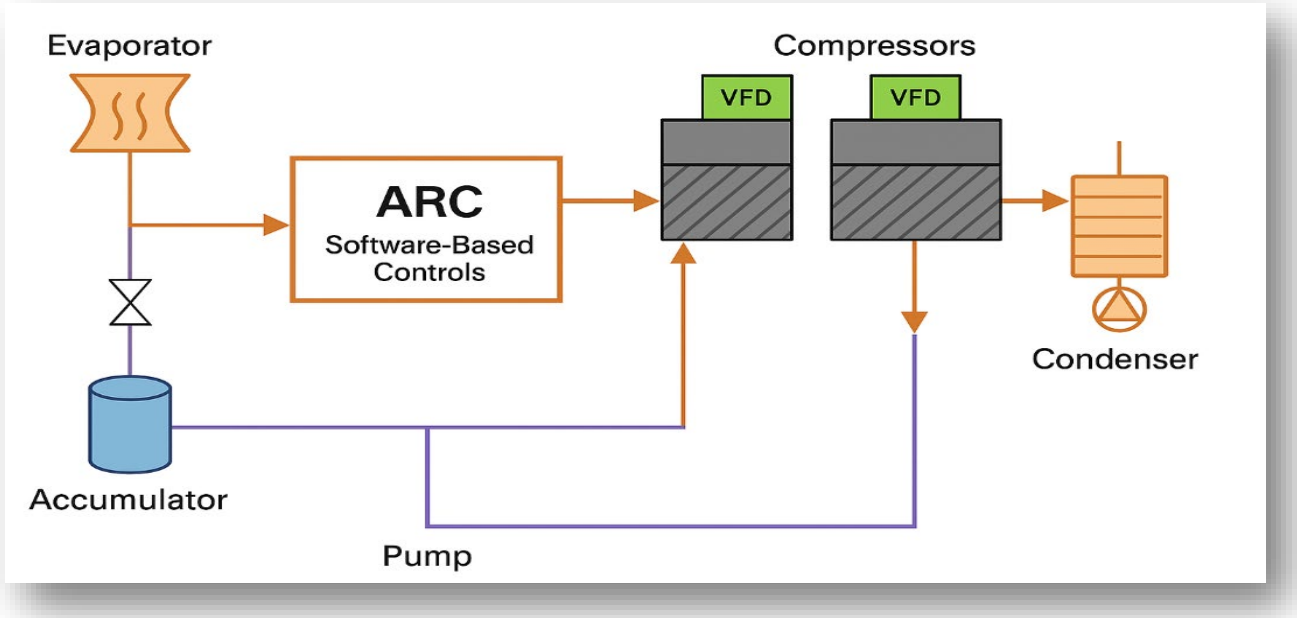
Source: GSA

# Advanced Control for Refrigeration

## How it works

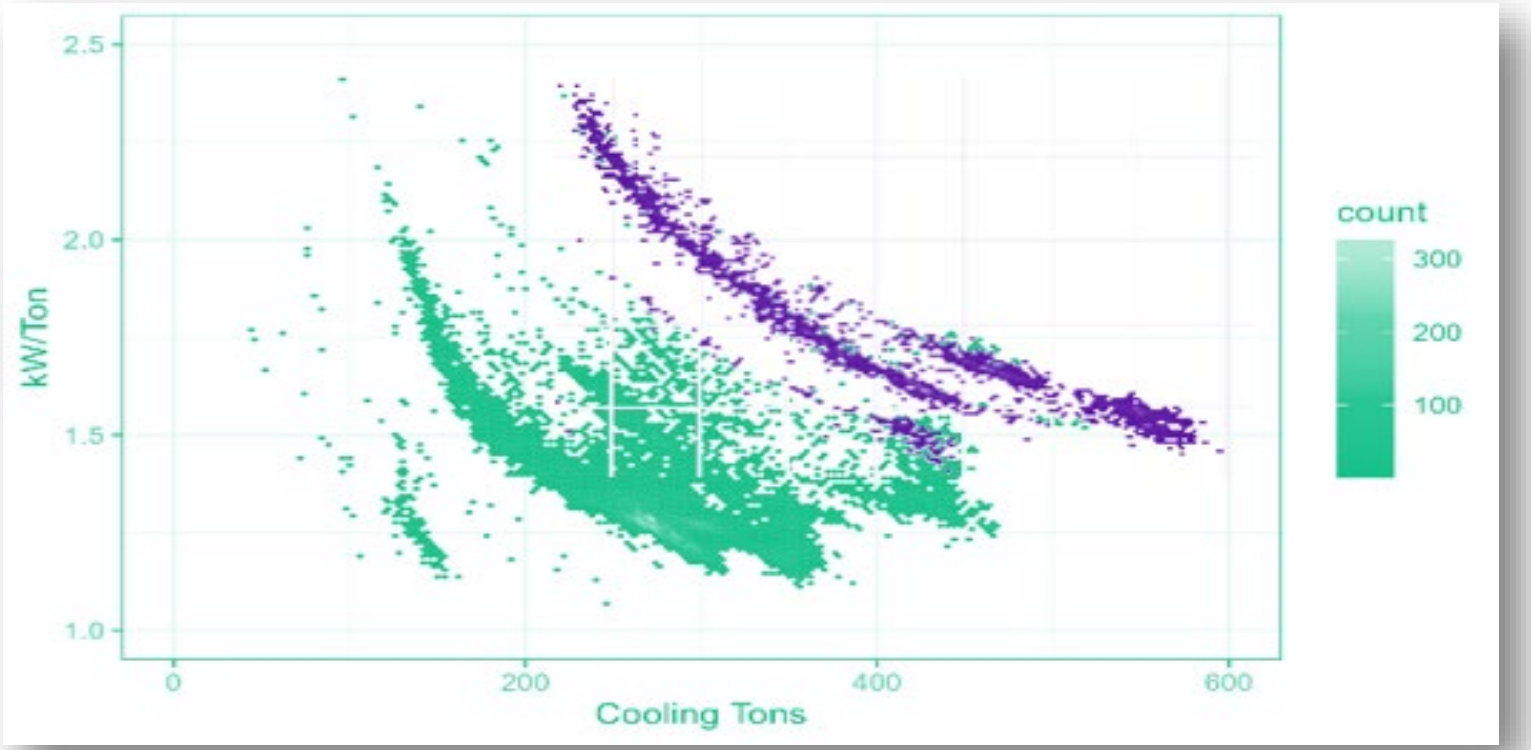
Interfaces with compressor controls (slide valve, VFDs, pressure sensors)

- Optimizes compressor staging, speed, run-time
- Reduces compressor load during peak
  - Overcools product during off-peak hours
  - Maintains safe temps using predictive control



# Advanced Control for Refrigeration

## Pilot in suburban Chicago



# Thank you for your time!

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